



SPRAGUE ELECTRIC COMPANY  
*1964 Annual Report to Employees*

COVER STORY ON PAGES 2 AND 3

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## MR. SPRAGUE, We were wondering—

**Question:** How would you characterize the general position of Sprague Electric at this time?

**ANSWER:** Beginning with the second half of 1964 our sales reversed their downward trend and an increase was noted. This increase is continuing into 1965 with good gains being made in commercial shipments. It is also interesting to report that we entered 1965 with the largest open order backlog in many years. Incoming orders in 1964 were up 14% from 1963. We also have introduced several new products in recent months and these, combined with orders already received, should account for substantially higher sales in 1965.

**Question:** With the development of new products and techniques won't our capital expenditures increase?

**ANSWER:** It has always been our policy to concentrate extensive effort on research and development. Beyond the initial stage any major new product requires a large outlay of money for equipment and facilities. We have invested considerable amounts of capital in developing these new products, and a continued large investment will be required to set-up our manufacturing facilities. The same fact is true in any business, and is a measure of our confidence in the future.

**Question:** In the past year we have heard a great deal about cost reduction. Will this continue throughout the coming year?

**ANSWER:** The electronics business is a highly competitive one, and in the past few years the competition has become more intense as many new companies have been established, some specializing in one or two areas of importance to us.

We must continue to give the closest possible attention to quality of product and to manufacturing efficiency. In addition, changing patterns of demand for electronic components will call for more varied technical skills and broader development programs that at any time in our history.

**Question:** Will the growing importance of semiconductors have an adverse effect on our other products? Do you believe that soon the only market will be for these new products?

**ANSWER:** To answer the second question first — There are many areas where semiconductors or integrated circuits do not function as well as the more conventional discrete components we all know so well. We will continue our standard lines for the foreseeable future. According to our best information the market for discrete components will continue to grow although at a much slower rate than the semiconductor market. With our new products we are increasing our product line so as to remain competitive in the marketplace as one of the world's largest suppliers of electronic components.

**Question:** From your answers, Mr. Sprague, should we conclude you are optimistic about the future?

**ANSWER:** I certainly am. Despite the many complexities of adapting to the changing trends in our business, I look forward to 1965 as a year of increasing sales of our products. Whether or not our earnings will also increase will depend on how successful we are in reducing costs.



**Our total INCOME for 1964 was \$86,608,472.**

## ***THIS IS WHERE THE MONEY WENT***

Sprague Electric's income for 1964 showed an encouraging gain over 1963. What was not encouraging was the drop in profits – a drop of half a million dollars even after adding a prior years' investment credit of over \$400,000.

By comparing the 1963 and 1964 figures on pages 8 and 9, you will note that the largest expense increase was in wages and salaries. The increase in the cost of supplies can be accounted for by our increased sales.



**WAGES AND  
SALARIES**

**47.7**

**\$41,328,499**



**SUPPLIERS**

**38.2**

**\$33,116,743**



**DIRECT TAXES**

**5.1**

**\$4,471,763**



**DEPRECIATION  
AND  
AMORTIZATION**

**3.6**

**\$3,156,790**





INTEREST ON  
BORROWED  
MONEY

**.9**  
**\$783,666**



WE PAID OUR  
STOCKHOLDERS

**2.1**  
**\$1,859,487**



WE REINVESTED  
IN THE BUSINESS

**2.6**  
**\$2,288,047**

**NET PROFIT**  
**\$3,746,703\***  
plus  
**\$400,831**  
prior years' investment credit

\*after deducting  
minority interest  
in the income of a  
subsidiary - \$4,308.

**M**any people think Sprague Electric's profit dollars are stashed away somewhere in a vault and are taken out periodically for someone to count and admire. Nothing could be further from the truth.

Profit dollars are working dollars. They work for the good of our employes, stockholders and customers as well as for the good of the communities where our various plants are located.

Here are some of the jobs our profit dollars do.

**... Profit dollars pay dividends to stockholders for the money they have invested in our Company.**

Stockholders expect to be paid for the use of their money just as anyone wants to be paid interest on money put into a savings account in a bank. They invest their money in our Company because they have confidence in us and in our ability to earn a profit. Attracting people with money to invest and keeping them interested in our business is one of the important jobs profit dollars do.

No one is anxious to invest their savings in a company which is not making a profit.

**... Profit dollars help to replace worn-out facilities.**

Everyone knows that old, worn-out machinery and tools must be replaced. It is equally

true that new machinery today costs considerably more than a similar item purchased a few years ago. Under our present tax laws, all Sprague Electric can set aside for a new machine is the cost of the old one — this is done through a depreciation allowance over a period of years.

When we go to purchase the new machinery, the additional cost must come from our profit dollars.

**... Profit dollars go to work to repay borrowed money.**

The money to pay off loans and keep our credit sound must come from profits.

**... Profit dollars go to work in research and development of new products.**

All manufacturing companies must have research and development programs to keep ahead of their competitors. This is particularly true in the electronics industry which we all recognize as one of the fastest changing industries.

When Sprague Electric was a fledgling concern it was decided that research was imperative to our survival. Mr. Sprague's 'research or die' statement has been widely publicized, and it was a sound decision. Over the years Sprague Electric has



expended large amounts of capital on research and this money has brought results in many new products. It will be our continuing policy to maintain our extensive research and engineering programs.

... Profit dollars go to work in modernizing plants and machinery and in adding new facilities.

Every time a new manufacturing process is started or an old one modernized with new equipment, the money is provided from profit dollars. If we want to continue to keep up with our competition and continue to provide jobs, we must develop better manufacturing processes as well as new products.

As our products become more complicated their methods of manufacture become more technical. You are all familiar with clean rooms and air conditioned work areas where conditions must meet rigid specifications to insure the desired reliability in the manufactured units. These are a far cry from the old, familiar table, chair and soldering iron, and in the future it will be necessary to provide more and more of these specialized manufacturing areas.

Where do we get this money? These are working dollars provided from profit.

Every dollar that is invested in new machinery, equipment and buildings makes Sprague

Electric a stronger, better company and assures employees they are working for a growing, progressive company.

... Profit dollars protect jobs.

Industry's big problem today is to replace tools and equipment as they wear out and become obsolete. The government permits companies to recover the original cost of a tool, but no more. For example: we may have paid \$10,000 for a machine some years ago. But to replace it today might cost \$15,000 or more. The difference has to be made up from working dollars that were saved by the Company, or by raising additional capital.

So what looks like a profit is really the amount needed to keep our tools of production efficient and competitive. The money can't be paid to stockholders nor reinvested for future progress. It's needed just to keep us where we are.

The capital equipment problem is faced by almost every company in the country. A recent study by Fordham University points out that one-third of our country's tools and machinery are obsolete, and that \$70 billion more of American productive equipment will be ready for the scrap pile by 1970.

Profits... working dollars... are the lifeblood of industry and a growing economy.



# THE FOURTH DECADE COMMITTEE

## *Our Long Range Planning Group*

**A**t Sprague Electric we view planning as a way of organizing and using our knowledge about our business and our industry to control future development. Necessarily, every facet of the Company must be involved in this undertaking, and therefore the long-range planning function is performed by a committee composed of the senior executives in research, engineering, marketing, sales, manufacturing, finance, industrial relations, and corporate planning and development. We call our group the Fourth Decade Committee, a name which originated in the first assignment the Committee was given when it was formed in 1959 to establish growth targets for the Company in the fourth decade of its history — the years from 1958 to 1967.

The history of the Fourth Decade Committee parallels in many ways the history of the electronics industry in recent years. In virtually every segment of the industry 1959 was the year of the electronics explosion. Growth rates turned upward sharply that year in the industrial, government, and consumer markets for electronic components. It was in 1959, for example, that the fabulous future of transistors first became clearly visible on industry charts.

### GROWTH TARGETS

In 1959 Sprague Electric sales passed the \$50,000,000 mark for the first time and were some 30% higher than sales in 1958. Net profit was more than doubled. It was at this point that the Fourth Decade Committee came into being.

The Committee's initial goals included the establishment of reasonable targets for both sales and profits for each of the years immediately ahead up to 1967, the end of the Company's fourth decade. The Committee also intended to study all of the steps that would be required to implement our growth program. To avoid unwarranted optimism, the long-term projections were based on a set of conservative assumptions. For example, it was assumed that neither boom nor bust would characterize 1967, and that the average growth of the Gross National Product over the period would run between 3 and 4 per cent. To date these assumptions have proved to be correct.

This approach to the establishment of growth goals is a clear illustration of Sprague Electric's concept of planning as a way to determine its future. For its first three decades, sales and profits had been increasing at a compound rate of 16% annually. Indeed, in each of the first three decades, sales and earnings had more than quadrupled over the previous decade. In those first thirty years such growth rates were achieved comfortably and without undue strain, even though they far surpassed the industry in general. It was clear, however, that to maintain such growth rates through the fourth decade would over-tax the Company's financial and manpower resources. Consequently, one of the Fourth Decade Committee's original decisions represented a sort of compromise — for the period from 1958 through 1967 it projected a corporate growth rate of 12% annually in sales and earnings, against an anticipated industry growth rate of about 8-10%. In the first half of the decade this target was substantially exceeded. In the sixth and seventh years, 1963 and 1964, we have not done so well. This was largely due to the important opportunities for future growth opened up by the newer technologies of electronic circuitry which have required the expenditure of much larger sums for new product development than were contemplated in the original 1959 projections. Time will tell whether we can get back on target over the remaining three years of the decade. We believe we will.

Increasingly over the years, the Fourth Decade Committee has concerned itself with formalizing Sprague Electric's overall business planning activity. The Committee meets monthly and its agenda may call for discussion of possible acquisitions or affiliations, or for a decision to move into a new product area. The Committee may devote time to technical considerations, such as whether to use computers to design microcircuits. The Fourth Decade Committee is a working group and its members are given specific study and action assignments covering the aspects of the business for which they are individually responsible. Results of these assignments are reported to the Committee each month.



*Committee members (beginning with Robert C. Sprague, Chairman of the Board and Chief Executive Officer, and proceeding down the far side) include: Bruce R. Carlson, Vice President, Corporate Planning and Systems; David B. Peck, Vice President, Special Components Division; Frederick R. Lack, Senior Vice President, Research; Dr. John L. Sprague, Senior Vice President, Engineering; Dr. Walter J. Bernard (standing), Associate Director of Engineering; Dr. Frederick M. Fowkes, Director of Research; and Dr. F. Lincoln Vogel, Associate Director of Research.*

*Standing at the far end of the table is Ernest L. Ward, President. Proceeding down the table are: Robert E. Kelley, Senior Vice President, Legal; John H. Winant, Vice President, Industrial Relations; Robert C. Sprague, Jr., Senior Vice President, Corporate Relations; Carroll G. Killen, Vice President, Industrial and Military Sales; and Neal W. Welch, Senior Vice President, Marketing and Sales.*

## FORMAL BUSINESS PLANNING ACTIVITY

In all of the Committee's discussions, the dominant note is change and growth — within the industry in general, and specifically at Sprague Electric. As new opportunities are discovered, either in terms of markets or technologies, projections of potential demand for Sprague Electric products are constantly being revised and reoriented. Once the Committee is satisfied that a particular projection is sound, a course of action is agreed upon. For example, the Fourth Decade Committee recently

made the decision to build the new microelectronics production facility at Worcester. In a direct way this decision reflects the Committee's estimates of the developing market potential in the field of microelectronics.

The Fourth Decade Committee at Sprague Electric is not merely an adjunct to management, but an integral part of management, working to maintain a close watch on the industry itself and on Sprague Electric's ability to keep abreast of developments within the industry.



# TEN-YEAR FINANCIAL SUMMARY

		1964 (Note B)
<b>Operating Results</b> (excluding nonrecurring items)	(In thousands of dollars)	
	NET SALES . . . . .	\$85,700
	Other Income . . . . .	908
	TOTAL INCOME . . . . .	86,608
	COSTS AND OTHER CHARGES:	
	Cost of Sales and Expenses . . . . .	74,445
	Depreciation and Amortization . . . . .	3,157
	Taxes, other than Federal Income Taxes . . . . .	2,800
	Interest Expense . . . . .	784
	PROFIT BEFORE FEDERAL TAXES AND MINORITY INTEREST . . . . .	5,422
	MINORITY INTEREST . . . . .	4
	FEDERAL INCOME TAXES . . . . .	1,671
	NET PROFIT . . . . .	3,747
	(Note A)	
	NET PROFIT PER SHARE:	
	On Shares Outstanding at Year End . . . . .	2.37
	Adjusted* . . . . .	2.37
	(Note A)	
	DIVIDENDS . . . . .	1,859
	DIVIDENDS PER SHARE . . . . .	1.20
	+ 2% stock*	
	BALANCE OF INCOME RETAINED IN THE BUSINESS (Note A)	1,888
<b>Financial Position at Year End</b>	CURRENT ASSETS . . . . .	49,161
	CURRENT LIABILITIES . . . . .	11,138
	NET WORKING CAPITAL . . . . .	38,023
	NET FIXED AND OTHER ASSETS . . . . .	28,555
	LONG TERM DEBT . . . . .	15,251
	OTHER LIABILITIES . . . . .	112
	STOCKHOLDERS' EQUITY . . . . .	51,214
	Dollars Per Share (Book Value) . . . . .	32.37
	CAPITAL EXPENDITURES . . . . .	3,906
<b>General Information</b>	NUMBER OF EMPLOYEES . . . . .	8,100
	NUMBER OF SHARES:	
	Outstanding at Year End . . . . .	1,582,110
	Adjusted* . . . . .	1,582,110
	NUMBER OF STOCKHOLDERS . . . . .	4,727

\* Adjusted cumulatively to reflect 2% stock dividends paid annually 1959-1964.

NOTES: (A) Excludes \$400,831 of nonrecurring income from restoration of prior years' investment credits, equivalent to \$0.25 per share.

(B) Includes the accounts of European subsidiaries acquired in 1956 and subsequent thereto, not previously consolidated. The years 1956 through 1960 have not been restated to include the accounts of European subsidiaries because the effect would be immaterial.

(C) Excludes additional Federal income taxes for the years 1941-1946 of \$439,075 and interest thereon of \$468,090 less Federal tax on the interest of \$243,407 and transfer from appropriated retained earnings of \$300,000, equivalent to \$0.24 per share (\$0.23 per share adjusted).

*Sprague Electric Company and Consolidated Subsidiaries*

1963 (Note B)	1962 (Notes B & D)	1961 (Notes B & D)	1960 (Note D)	1959	1958	1957	1956	1955
\$83,261	\$86,955	\$77,254	\$64,524	\$56,352	\$43,194	\$46,187	\$44,660	\$44,353
642	447	396	340	382	344	292	361	327
83,903	87,402	77,650	64,864	56,734	43,538	46,479	45,021	44,680
70,373	70,046	61,802	53,115	46,516	37,671	39,531	38,092	36,041
2,882	2,675	2,416	1,940	1,718	1,551	1,447	1,401	1,254
3,195	2,995	2,471	1,888	1,588	1,082	1,226	1,234	1,241
623	440	212	91	64	66	76	85	103
6,830	11,246	10,749	7,830	6,848	3,168	4,199	4,209	6,041
16	3	24	—	—	—	—	—	—
2,185	4,813	4,632	3,743	3,346	1,406	1,979	2,033	3,038
4,629	6,430 (Note C)	6,093	4,087 (Note E)	3,502	1,762	2,220	2,176	3,003
2.99	4.25	4.14	2.85	2.61	1.41	1.78	1.75	2.42
2.93	4.09 (Note C)	3.91	2.64 (Note E)	2.36	1.24	1.57	1.54	2.13
1.817	1,773	1,726	1,666	1,555	1,495	1,492	1,490	1,490
1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
+ 2% stock	+ 2% stock	+ 2% stock	+ 2% stock	+ 2% stock				
2,812	4,657 (Note C)	4,367	2,421 (Note E)	1,947	267	728	686	1,513
43,229	40,905	34,710	27,370	22,424	16,805	17,256	17,381	17,463
6,561	16,358	12,528	10,437	5,824	3,772	3,886	4,350	4,378
36,668	24,547	22,182	16,933	16,600	13,033	13,370	13,031	13,085
27,631	25,978	23,830	20,281	14,255	12,611	12,191	11,948	11,482
15,360	4,594	4,680	798	1,064	1,330	1,597	1,864	2,131
75	60	47	—	—	—	—	—	—
48,864	45,871	41,285	36,416	29,791	24,314	23,964	23,115	22,436
31.56	30.33	28.05	25.40	22.23	19.48	19.25	18.60	18.07
4,227	4,575	5,565	4,850	2,965	2,043	1,832	1,631	2,586
7,600	8,200	7,200	6,400	5,900	4,900	5,500	5,700	6,000
1,548,362	1,512,590	1,471,709	1,433,449	1,340,229	1,247,912	1,244,987	1,242,712	1,241,712
1,577,864	1,571,165	1,558,637	1,548,137	1,482,133	1,415,447	1,412,522	1,410,247	1,409,247
3,824	3,674	3,645	2,804	2,463	2,643	2,643	2,571	1,939

(D) Adjusted where applicable to reinstate goodwill arising from acquisition of subsidiaries, which previously had been charged off to retained earnings at acquisition date.

(E) Excludes \$795,279 of nonrecurring profit from sales of patents, less applicable taxes (including Federal income tax of \$291,375), equivalent to \$0.55 per share (\$0.51 per share adjusted).

# We visit the Camden Sales Office...

The Camden Sales Office was opened in 1954 headed by Wilmer S. Trinkle, President of Trinkle Sales Company, who had been handling Sprague Electric and Sprague Products accounts in that area since 1935 as an independent representative.

With the death of Mr. Trinkle in 1958, Arthur J. Christopher, Jr. transferred to Camden from the home offices in North Adams to head the Sales Office group. At the same time Charles Janton, Jr., an employee of Trinkle Sales for many years, joined Sprague Electric.

In 1962 with the continued expansion of operations and personnel the office was moved to Northgate Plaza, the present location. The Camden Office is responsible for sales engineering contracts in Southern New Jersey, Eastern Pennsylvania, Maryland and Delaware. In addition to Mr. Christopher the office is staffed by three product specialists, three sales engineers, and two secretaries.

Mr. Christopher joined Sprague Electric in 1950 in the Research and Engineering Department in North Adams, following graduation from the Carnegie Institute of Technology with a bachelor of science degree in electrical engineering. While in North Adams he did graduate work at Williams College, Williamstown, Massachusetts and has continued his studies at Rutgers University in Camden.

From 1954 to 1956 Mr. Christopher served in the U. S. Army Signal Corps and upon his discharge returned to Sprague Electric as a Product Specialist in the Field Engineering Department. He was named to his present position as District Manager in 1958.

Charles Janton joined Trinkle Sales in 1947 and continued with that organization until the death of Mr. Trinkle in 1958 when he transferred to Sprague Electric. A native of Philadelphia he graduated from Central High School there and from Drexel Institute of Technology.

From 1941 to 1946 Mr. Janton served in the U. S. Army as a Captain.

A native of Fort Jackson, New York, Martin Clifford joined Sprague Electric in 1959 as a Sales Engineer at the Camden Office. Prior to that time he had been employed for sixteen years by the Philco Corporation as Manager of Standards and Reliability.

Mr. Clifford is a graduate of Clarkson College with a bachelor of science degree in electrical engineering, and following graduation taught school for several years including three years at Clarkson College.

Alex Ferris is a native of Lowell, Massachusetts and a graduate of Tufts College and Lowell Technological Institute. He served in the U. S. Navy from 1955-1958 as a Disbursing Officer and joined Sprague Electric in 1962 as a Resistor Product Specialist.

A native of Philadelphia, Kenneth MacNeil has an associate degree in engineering from Pennsylvania Military College, Chester, Pennsylvania and is continuing his studies in evening school toward a BSEE degree. He served in the U. S. Navy from 1953-1957 as an Electrician's Mate and prior to joining Sprague Electric in 1962 was employed by the RCA Missile and Surface Radar Division, Moorestown, New Jersey.

The newest addition to the Camden's Sales Office staff is Alfred Currie who joined the group about a year ago following six years with Philco Corporation in their Semiconductor Division.

Mr. Currie is a native of Haneford, Pennsylvania and a graduate of Drexel Institute of Technology with a bachelor of science degree in electrical engineering. He served in the U. S. Navy from 1946-1948 and prior to joining Philco Corporation had been employed by the Rheem Manufacturing Company in Philadelphia and Hughes Aircraft in Tucson, Arizona.



Arthur J. Christopher, Jr., District Manager, has been in charge of the Camden Office since 1958.



Resistor Product Specialist Alex Ferris (left) and Kenneth MacNeil discuss a specification.



Mr. Christopher (right) discusses a sales problem with Sales Engineers Charles Janton, Jr. (left) and Kenneth MacNeil (center).

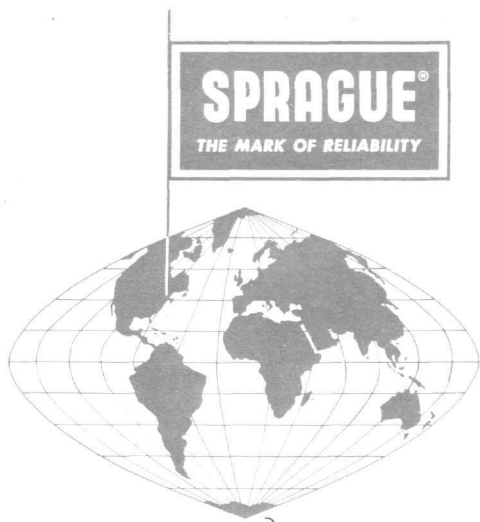
Martin Clifford (left), Sales Engineer, and Charles Janton check a customer's requirements.



Alex Ferris (left) compares the units in which he specializes with the tiny transistors handled by Alfred Currie, Transistor Product Specialist.

The general scene at the office is one of activity as orders are received from our many customers.





## Recent FOREIGN SALES Activities

On January 21 and 22 the first 1965 overseas sales meetings, led by Gerard V. Tremblay, Director of International Sales, were held in the Sprague World Trade offices in Zurich, Switzerland. The theme of the Conference was "Sales at a Profit". Sprague Electric's domestic sales methods have been successful and it is the intention of Sprague World Trade to duplicate these wherever possible.

The meeting technique followed the lines recently worked out by our own Field Engineering group, with one innovation - a page was copied from the North Adams radio program, "LOG of the Air". Prior to leaving for the Conference Mr. Tremblay taped interviews with Product Specialists in North Adams. These were played back and discussions were held following each taped message. In this manner two sales development points were combined:

1. Product Knowledge
2. Sales Presentation Improvement

There is a sizeable European market for Sprague Electric products manufactured in the United States. Therefore, the task of the Sprague World Trade organization is to expand sales activities thereby increasing employment in our plants in the United States.

Plans were also made for the forthcoming In-

ternational Components Exposition to be held in Paris in April. This is the largest show in the world held specifically for components. In attendance it is second only to our IEEE Show held in New York each year.

Attending the Zurich meeting were Sprague representatives from all over the world. Traveling the greatest distance was Rudolph Lederhofer, Plant Manager and Sales Manager of our Hong Kong operations, who had been on a combined business and vacation trip to South Africa and returned by way of Zurich to attend the Meeting.

Also attending were Pierre Stroobants, recently appointed Manager of Sprague Electromag in Renaix, Belgium; Dr. de Marines, Sales Manager of Sprague-CREAS in Milan, Italy; Mario Fortini, Marketing Manager of Semi-conductors for Sprague World Trade; George Meier, Manager of the German Technical Office; Didier Franc, Manager of the French Technical Office; and Peter Kraehenbuehl, Manager of the Zurich Office.

Also introduced at the Meeting was Robert Sotty who recently joined our French Office staff. Mr. Sotty was formerly employed by SINTRA, a leading French electronics firm, where he was a Components Engineer.



## OFFICERS AND DIRECTORS

### SPRAGUE ELECTRIC COMPANY

#### OFFICERS

ROBERT C. SPRAGUE, Chairman of the Board and Treasurer  
 ERNEST L. WARD, President  
 NEAL W. WELCH, Senior Vice President Marketing and Sales  
 ROBERT C. SPRAGUE, JR., Senior Vice President Corporate Relations  
 FREDERICK R. LACK, Senior Vice President Research  
 JOHN L. SPRAGUE, Senior Vice President Engineering  
 ROBERT E. KELLEY, Senior Vice President Legal  
 DAVID B. PECK, Vice President Special Components Division  
 HOLLIS R. WAGSTAFF, Vice President Fiscal  
 CARROLL G. KILLEN, Vice President Industrial and Military Sales  
 BRUCE R. CARLSON, Vice President Corporate Planning and Systems  
 H. KENNETH ISHLER, Vice President Semiconductor Division  
 FRANCIS G. JENKINS, Vice President Purchasing  
 JOHN H. WINANT, Vice President Industrial Relations

#### DIRECTORS

ARTHUR G. CONNOLLY  
 JOSEPH A. ERICKSON  
 ROBERT E. KELLEY  
 FREDERICK R. LACK  
 WILLIAM J. NOLAN  
 GORDON W. PHELPS  
 PRESTON ROBINSON

JOHN L. SPRAGUE  
 ROBERT C. SPRAGUE  
 ROBERT C. SPRAGUE, JR.  
 ERNEST L. WARD  
 NEAL W. WELCH  
 JEROME B. WIESNER  
 JERROLD R. ZACHARIAS



On March 27, 1964 the Board of Directors of Sprague Electric Company announced the election of a new senior vice president, three vice presidents, and a director.

Robert E. Kelley was named Senior Vice President, Legal replacing William J. Nolan who retired from that position but remained as a Director and Consultant. Elected vice presidents were: H. Kenneth Ishler, Francis G. Jenkins and John H. Winant. The new vice presidents all represented promotions from within the Company.

Dr. Jerome B. Wiesner was re-elected a Director following his return to Massachusetts Institute of Technology from a Presidential appointment in Washington as Special Advisor to the White House for Science and Technology.



Robert C. Sprague



Ernest L. Ward



Neal W. Welch



Robert C. Sprague, Jr.



Frederick R. Lack



John L. Sprague



Robert E. Kelley



David B. Peck



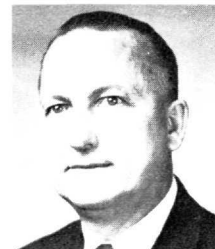
Hollis R. Wagstaff



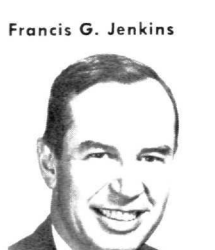
Carroll G. Killen



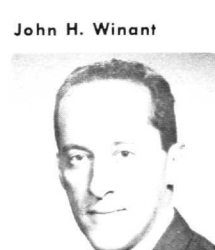
Bruce R. Carlson



H. Kenneth Ishler



Francis G. Jenkins



John H. Winant

# OUR PROGRESS IN SEMICONDUCTORS

**A**t the present time our semiconductor manufacturing operations are centered at the Concord, New Hampshire Plant, but plans were recently announced for a large new manufacturing facility to be located in Worcester, Massachusetts.

The year just ended saw substantially increased industry sales of both discrete semiconductors, such as transistors and diodes, and of integrated circuits and functional assemblies of all types. Sprague Electric's sales of transistors and functional assemblies shared in the growth in demand for these devices, and our program for the development and manufacture of Silicon Integrated UNICIRCUITS® and Thin-film CERACIRCUITS® continued to expand in both size and scope.

In 1964, shipments of transistors from the Concord Semiconductor Division were double that of the previous year. Sales were increased as a result of the introduction of new types, such as our SEPT® (Silicon Epitaxial Planar Transistors) and also from additional volume from former customers of Philco Corporation.

A number of new transistor types were introduced during the year, including MADT® high-speed switches and amplifiers, SPAT® low-level, high-speed choppers, and a variety of SEPT® transistors for high-speed switching applications. We also announced our DUET® Dual Emitter-chopper Transistor as the first of a line of multiple transistors and diode chips in a single package. These, and

other components compatible with integrated circuits, are expected to find increasing use for applications not presently possible with diffused monolithic circuits.

In the coming months we expect to announce additional lines of medium-speed silicon circuits employing isolation diffusion and resistor-transistor logic, as well as an ultra-high speed line employing diode-transistor logic. The technology of active-substrate microelectronic circuitry is changing rapidly, and Sprague Electric development programs are underway in all of the significant areas, including field effect devices and metal oxide-silicon (MOS) circuits, metal-base semiconductors, and circuits that combine diffused active devices with thin-film passive components vacuum deposited directly onto the silicon chip.

A substantial market exists for thin-film functional assemblies which are not complete circuits in that they do not contain any active devices. These are our METANET® Metal-film Precision Resistor Modules for use in digital computers, where they permit substantial savings in assembly cost and packaging densities. These modules contain extremely stable and reliable true metal-film resistors proprietary to Sprague Electric, and are finding widespread application in the so-called "third-generation" computers, where they are particularly important in peripheral circuitry such as input-output and storage devices.

Shown on the opposite page  
are scenes at the Semiconductor Division,  
Concord, New Hampshire.



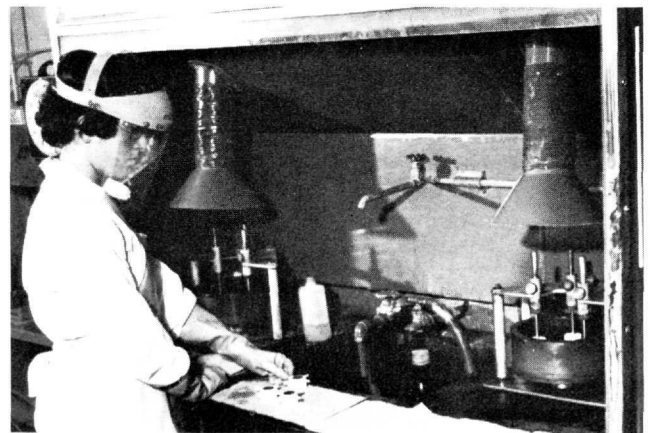
Philis Williams is assembling components into carbon jigs. These components are then passed through a controlled high temperature furnace to diffuse the metal and glass parts together, making a "Flat Pack" Hermetic Sealed Container for Unicircuit® components.



Elwood Roberts is taking a temperature reading of the surface in the Epitaxial silicon being grown in the reactor. This system for generating Epitaxial silicon on a highly polished silicon surface is required for micro transistors or Unicircuits®.



Ginger Cooper is doing "Angle Lapping". This process is used to determine the junction depth in silicon material.



Carolyn Berwick is in the process of loading a Teflon Paddle Wheel on which a silicon wafer is mounted into an etching bowl. She wears protective head gear and gloves because the solutions required for etching are corrosive.



Operators from left to right are: Mary Ann Foley, Carolyn Hillsgrove, Carol Bellemare, Joyce Fowler and Rita Beauchesne. Working in a superclean area with the work in process in either "laminar flow hoods" or covered they are carrying out the various processing steps essential for photolithographic masking.



Dorothy Plante is checking a multiple diamond scribe. The machine oscillates back and forth on germanium wafers and automatically indexes after each group of scribes. After all have been done in one direction, the work is removed and rotated 90° to generate the "Germanium Dice" essential for manufacturing certain of Sprague transistors.

# SEMICONDUCTORS

Although the volume of shipments of complete thin-film integrated circuits has not yet attained the level of monolithic silicon circuit shipments, it appears their growth will accelerate over the next few years as process techniques improve and as better uncased transistors and diodes become available for incorporation in hybrid circuits. In the long run, we believe the distinction between thin-film circuits and monolithics will become somewhat academic, as what now appear to be two separate and distinct technologies blend to a point where they are indistinguishable.

At present integrated circuits exhibit more satisfactory operating characteristics when used in digital circuitry than they do in linear circuitry. Looking ahead a few years, however, linear applications should begin to catch up as better means become possible for realizing the wide variety of linear functions that characterize most industrial and commercial circuit applications, other than digital computers and data-handling systems. Although combinations of semiconductor and thin-film techniques, offer considerable promise for many types of linear circuits, they nevertheless leave much to be desired in terms of simplicity and cost. We believe that fundamental break-throughs in the field of circuit design are needed to open up the large potential markets for integrated circuitry in the industrial and consumer markets for electronic equipment.

Sprague Electric has, therefore, undertaken an extensive development program in which the principles of semiconductor device physics are coupled with those of modern network theory to realize a

coherent approach to integrated circuit design. This activity is being carried on by an advanced development group in our Microelectronics Engineering Department in North Adams with the assistance of outstanding scientists from the University of California and New York University. Initially, network synthesis procedures are being applied to the design of selective variable-gain amplifiers. Other new techniques, such as computer-aided design of microcircuits, and utilization of a variety of material properties for electrical functions, will be incorporated in the program. The resulting design procedures are expected to lead to significant improvements in the flexibility and speed of response in a wide variety of system problems.

Our facilities for the design and production of both active and passive substrate circuits will be substantially increased during the year with the construction of our plant in Worcester, Massachusetts. Large-scale production of silicon and ceramic-based microcircuits is planned, together with other new semiconductor products to be announced during the year.

As we look ahead to the future for electronic components and circuits, it seems quite clear that microelectronic circuits will afford the largest single opportunity for growth to the components manufacturer. To share in this growth, we must master all of the basic technologies of semiconductors, thin films, passive components, and circuit synthesis so as to be in a position to work intelligently with our customers in the realization of their circuit needs.

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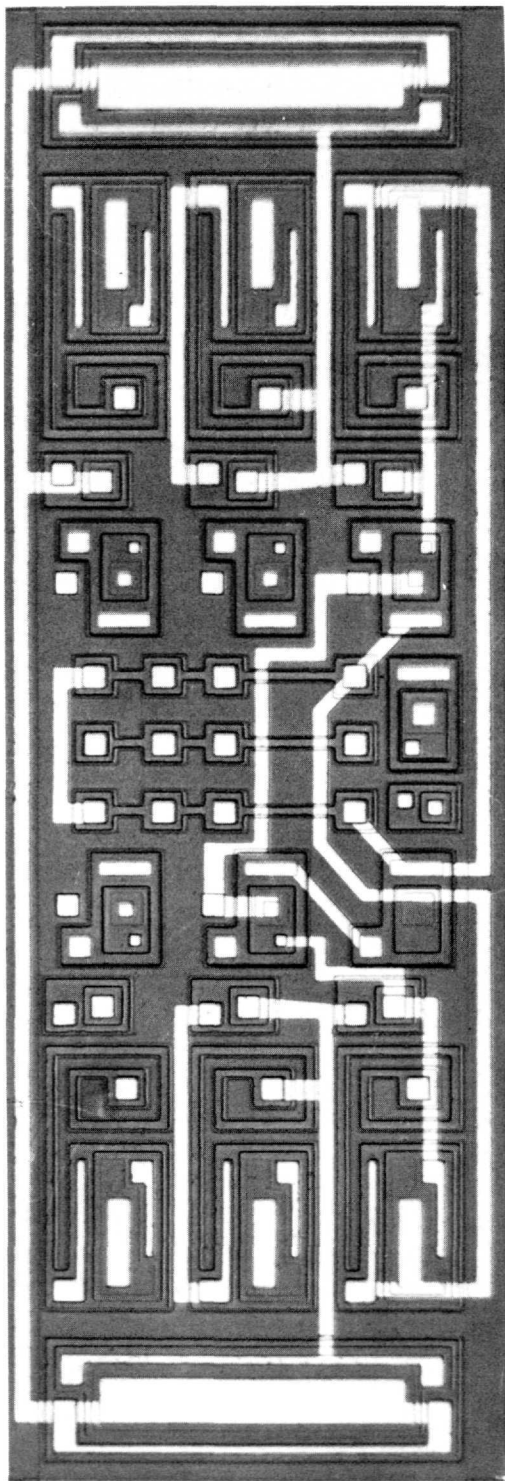
Sprague Electric Company advertises extensively in the leading trade magazines. Shown on the opposite page is a recent advertisement for our patented UNICIRCUITS.

The ad appeared in the following trade journals:

Electronics  
Electronic News  
Solid State Design  
Electronic Capabilities  
Electronic Industries  
Industry  
Spectrum  
Electrical Design News  
Proceedings of the IEEE

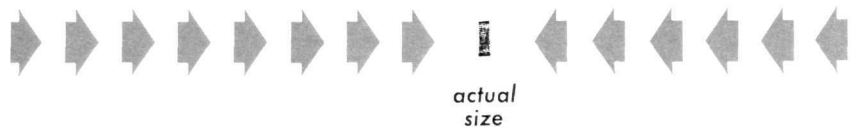


**Now from Sprague!**



# UNICIRCUIT<sup>®</sup>

## INTEGRATED CIRCUITS



This is a master-matrix UNICIRCUIT, interconnected to meet the requirements of a military systems manufacturer for an RS flip-flop. The photograph at the left, enlarged 38 diameters (1444 times area), speaks for itself as to the technical capability of the Sprague Electric Company to produce complex silicon monolithic integrated circuits.

If you would like to discuss your integrated circuit needs with an old-line established electronic components manufacturer who has a proven reputation for reliability, please write or telephone Mr. Albert B. Dall, Marketing Manager, Semiconductor Division, Sprague Electric Company, Concord, New Hampshire.

area 603 Tel. 224-1961

### SPRAGUE COMPONENTS

INTEGRATED CIRCUITS  
THIN-FILM MICROCIRCUITS  
CAPACITORS  
TRANSISTORS  
RESISTORS

PULSE TRANSFORMERS  
INTERFERENCE FILTERS  
PULSE-FORMING NETWORKS  
TOROIDAL INDUCTORS  
ELECTRIC WAVE FILTERS

CERAMIC-BASE PRINTED NETWORKS  
PACKAGED COMPONENT ASSEMBLIES  
BOBBIN and TAPE WOUND MAGNETIC CORES  
SILICON RECTIFIER GATE CONTROLS  
FUNCTIONAL DIGITAL CIRCUITS



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